

What is claimed is:

1. A method for setting a new reference value for managing bi-directional relationships between objects in an object model, the method comprising the steps of:

- receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships;
- creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships;
- receiving a new reference value to be set in a selected object relating to a bi-directional relationship;
- determining, using one or more of the proxy objects, a new peer value to be set for a peer object which has the bi-directional relationship with the selected object; and
- setting the new peer value to a proxy object created for the peer object.

✓ 2. The method as claimed in claim 1, wherein the bi-directional relationship information receiving step comprises the steps of:

- receiving object model meta-data defining relationships between objects in the object model; and
- retrieving reference value information that represents reference values indicating current peer objects for the bi-directional relationships.

✓ 3. The method as claimed in claim 1, wherein the bi-directional relationship information receiving step receives the reference value information from a data storage in which data corresponding to the objects is stored.

✓ 4. The method as claimed in claim 1, wherein the bi-directional relationship information receiving step receives the reference value information from a new object that is newly created by a user.

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- ✓ 5. The method as claimed in claim 1, wherein the bi-directional relationship information receiving step receives the reference value information that includes a collection of reference values for a bi-directional relationship object which references many peer objects.
- ✓ 6. The method as claimed in claim 1, wherein the proxy object creating step creates proxy objects at uni-directional peer relationships that comprise bi-directional relationships.
- ✓ 7. The method as claimed in claim 6, wherein the proxy object creating step creates a proxy object for each of a pair of one-to-one uni-directional peer relationships that form a one-to-one bi-directional relationship.
- ✓ 8. The method as claimed in claim 6, wherein the proxy object creating step creates a proxy object for each of a one-to-many uni-directional peer relationship and one-to-one uni-directional peer relationships that form a one-to-many bi-directional relationship.
- ✓ 9. The method as claimed in claim 6, wherein the proxy object creating step creates a proxy object for each of uni-directional one-to-many peer relationships that form a many-to-many bi-directional relationship.
- ✓ 10. The method as claimed in claim 1, wherein the new peer value determining step comprises a step of passing the new reference value through related proxy objects that are related to the bi-directional relationship.
- ✓ 11. The method as claimed in claim 1, wherein the new peer value contains a collection of reference values which is determined based on the new reference value.
- ✓ 12. The method as claimed in claim 1, wherein the new reference value represents addition, removal or change of a reference value.

- ✓ 13. The method as claimed in claim 1, wherein the setting step sets a value null when the determining step determines to remove the bi-directional relationship.
- ✓ 14. The method as claimed in claim 1, wherein the setting step sets a new peer value by replacing an old reference value with the new peer value.
- ✓ 15. The method as claimed in claim 1 further comprising steps of:
determining, using one or more of the proxy objects, another new peer value to be set in a new peer object which is referenced by the new reference value set for the selected object; and
setting another new peer value to a proxy object created for the new peer object.
- ✓ 16. The method as claimed in claim 1 further comprising steps of:
determining, using one or more of the proxy objects, an updating reference value for a related object that is related to the selected object through one or more original or new bi-directional relationships; and
setting the updating reference value in a proxy object created for the related object.
- ✓ 17. The method as claimed in claim 16, wherein the updating reference value determining step and the updating reference value setting step are repeated for all related objects so as to maintain bi-directional relationship integrity.
18. The method as claimed in claim 16, wherein the updating reference value determining step comprises a step of passing the new reference value through related proxy objects that are created for the related objects.
19. A method for creating proxy objects for managing bi-directional relationships between objects in an object model, the method comprising the steps of:

19 receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships; and
creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships at peer relationships that comprise the bi-directional relationships, a created proxy object being capable of receiving a new reference value to be set in a selected object relating to a bi-directional relationship, determining, using one or more of the proxy objects, a new peer value to be set in a peer object which has the bi-directional relationship with the selected object, and setting the new peer value to a proxy object created for the peer object.

20. The method as claimed in claim 19, wherein the bi-directional relationship information receiving step comprises the steps of:

receiving object model meta-data defining relationships between objects in the object model; and

retrieving reference value information that represents reference values indicating current peer objects for the bi-directional relationships.

21. The method as claimed in claim 20 further comprising a step of setting proxy reference to the selected bi-directional relationship objects to indicate that the selected bi-directional relationship uses one or more proxy objects.

22. The method as claimed in claim 20, wherein the object model meta-data receiving step comprises a step of receiving attribute information regarding attributes of objects used to hold reference values indicating one or more peer objects which a bi-directional relationship object references; and the retrieving step retrieves the reference value information based on the attribute information.

23. The method as claimed in claim 20, wherein the retrieving step retrieves the reference value information that includes a collection of reference values for a selected bi-directional relationship object which references many peer objects.

24. The method as claimed in claim 20, wherein the retrieving step retrieves the reference value information from a data storage in which data corresponding to the objects is stored.
25. The method as claimed in claim 20, wherein the retrieving step retrieves the reference value information from a new object that is newly created by a user.
26. The method as claimed in claim 19, wherein the proxy object creating step creates proxy objects at uni-directional peer relationships that comprise bi-directional relationships.
27. The method as claimed in claim 26, wherein the proxy object creating step creates a proxy object for each of a pair of one-to-one uni-directional peer relationships that form a one-to-one bi-directional relationship.
28. The method as claimed in claim 26, wherein the proxy object creating step creates a proxy object for each of a one-to-many uni-directional peer relationship and one-to-one uni-directional peer relationships that form a one-to-many bi-directional relationship.
29. The method as claimed in claim 26, wherein the proxy object creating step creates a proxy object for each of uni-directional one-to-many peer relationships that form a many-to-many bi-directional relationship.
30. The method as claimed in claim 19, wherein the new peer value contains a collection of reference values which is determined based on the new reference value.
31. The method as claimed in claim 19, wherein the new reference value represents addition, removal or change of a reference value.

32. A method for maintaining bi-directional relationship integrity between objects in an object model, the method comprising the steps of:

- receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships;
- creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships;
- receiving a new reference value to be set in a selected object relating to a bi-directional relationship;
- determining, using one or more of the proxy objects, an updating reference value for a related object that is related to the selected object through one or more original or new bi-directional relationships;
- setting the updating reference value in a proxy object created for the related object; and
- repeating the updating reference value determining step and the updating reference value setting step for all related objects so as to maintain bi-directional relationship integrity.

33. The method as claimed in claim 32, wherein the updating reference value determining step comprises a step of passing the new reference value through related proxy objects that are created for the related objects.

34. A bi-directional relationship manager for setting a new reference value for managing bi-directional relationships between objects in an object model, the bi-directional relationship manager comprising:

- a bi-directional relationship information receiver for receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships; and
- a proxy object creator for creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships at peer relationships that comprise the bi-directional relationships, a created proxy object receiving a new reference value to be set in a selected object relating to a bi-directional relationship, determining, using one or

more of the proxy objects, a new peer value to be set in a peer object which has the bi-directional relationship with the selected object, and setting the new peer value to a proxy object created for the peer object.

35. The bi-directional relationship manager as claimed in claim 34, wherein the bi-directional relationship information receiver comprises:

a meta-data receiver for receiving object model meta-data defining relationships between the objects; and

a reference value retriever for retrieving reference value information that represents reference values indicating current peer objects for the bi-directional relationships.

36. The bi-directional relationship manager as claimed in claim 35, wherein the meta-data receiver receives attribute information regarding attributes of objects used to hold reference values indicating one or more peer objects which a bi-directional relationship object references; and the reference value retriever retrieves the reference value information based on the attribute information.

37. The bi-directional relationship manager as claimed in claim 35, wherein the reference value retriever retrieves the reference value information that includes a collection of reference values for a selected bi-directional relationship object which references many peer objects.

38. The bi-directional relationship manager as claimed in claim 35, wherein the reference value retriever retrieves the reference value information from a data storage in which data corresponding to the objects is stored.

39. The bi-directional relationship manager as claimed in claim 35, wherein the reference value retriever retrieves the reference value information from a new object that is newly created by a user.

40. The bi-directional relationship manager as claimed in claim 34, wherein the proxy object creating step creates proxy objects at uni-directional peer relationships that comprise the bi-directional relationships.

41. The bi-directional relationship manager as claimed in claim 40, wherein the proxy object creating step creates a proxy object for each of a pair of one-to-one uni-directional peer relationships that form a one-to-one bi-directional relationship.

42. The bi-directional relationship manager as claimed in claim 40, wherein the proxy object creating step creates a proxy object for each of a one-to-many uni-directional peer relationship and one-to-one uni-directional peer relationships that form a one-to-many bi-directional relationship.

43. The bi-directional relationship manager as claimed in claim 40, wherein the proxy object creating step creates a proxy object for each of uni-directional one-to-many peer relationships that form a many-to-many bi-directional relationship.

44. A proxy object for setting a new reference value for managing bi-directional relationships between objects in an object model, the proxy object comprising:
a new value receiver for receiving a new reference value to be set in a selected object relating to a bi-directional relationship;
a new peer value determiner for determining a new peer value to be set in a peer object which has the bi-directional relationship with the selected object, the new peer value determiner using bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships; and
a new peer value setter for setting the new peer value to a proxy object created for the peer object.

45. The proxy object as claimed in claim 44, wherein the new peer value determiner determines the new peer value by passing the new reference value through related proxy objects that are related to the bi-directional relationship:

~~46. The proxy object as claimed in claim 44, wherein the new peer value contains a collection of reference values which is determined based on the new reference value.~~

47. The proxy object as claimed in claim 44, wherein the new reference value represents addition, removal or change of a reference value.

48. Computer media storing the instructions or statements for use in the execution in a computer of a method for creating proxy objects for managing bi-directional relationships between objects in an object model, the method comprising the steps of:

receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships; and

creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships at peer relationships that comprise the bi-directional relationships, a created proxy object being capable of receiving a new reference value to be set in a selected object relating to a bi-directional relationship, determining, using one or more of the proxy objects, a new peer value to be set in a peer object which has the bi-directional relationship with the selected object, and setting the new peer value to a proxy object created for the peer object.

49. Electronic signals for use in the execution in a computer of a method for creating proxy objects for managing bi-directional relationships between objects in an object model, the method comprising the steps of:

receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships; and

creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships at peer relationships that comprise the bi-directional relationships, a created proxy object being capable of receiving a new reference value to be set in a selected object relating to a bi-directional relationship, determining, using one or more of the proxy

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objects, a new peer value to be set in a peer object which has the bi-directional relationship with the selected object, and setting the new peer value to a proxy object created for the peer object.

50. A computer program product for use in the execution in a computer of a method for creating proxy objects for managing bi-directional relationships between objects in an object model, the product comprising:

a module for receiving bi-directional relationship information indicating interrelation between objects having one or more bi-directional relationships; and

a module for creating proxy objects based on the bi-directional relationship information for selected bi-directional relationship objects having bi-directional relationships at peer relationships that comprise the bi-directional relationships, a created proxy object being capable of receiving a new reference value to be set in a selected object relating to a bi-directional relationship, determining, using one or more of the proxy objects, a new peer value to be set in a peer object which has the bi-directional relationship with the selected object, and setting the new peer value to a proxy object created for the peer object.